

Postharvest Grain Systems R&D

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**A BIBLIOGRAPHY OF PLANT
MATERIALS TESTED FOR
ACTIVITY AGAINST
STORED-PRODUCT INSECTS**



**FOOD & FEED GRAIN INSTITUTE
MANHATTAN, KANSAS 66506**

A BIBLIOGRAPHY OF PLANT MATERIALS TESTED FOR ACTIVITY
AGAINST STORED-PRODUCT INSECTS

Prepared by

Rosemary Burroughs
Donna Schenck-Hamlin
and
Valerie Wright

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Manhattan, Kansas 66506

Contribution No. 87-508-J, Department of Grain Science and Industry and Department of Entomology, Kansas State Agricultural Experiment Station, Kansas State University, Manhattan, Kansas

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EXECUTIVE SUMMARY

The bibliography documents laboratory investigations and field observations of plant materials and their chemical components tested or used to protect stored grains and legumes against destructive insect pests. The materials were utilized as insecticides, repellants, growth regulators, or barriers. To facilitate use of the more than 300 references, tables provide sources of information for plant species, vegetable oils, and crop residues.

Copies of the publications are available from the Postharvest Documentation Service of the Food and Feed Grains Institute, Kansas State University, Manhattan, Kansas 66506, USA.

SECTION I

INTRODUCTION

Some agricultural systems traditionally use various native plant materials to protect stored grains and legumes from destructive insects. The practices lost favor when synthetic pesticides became the accepted way to protect basic foods in subsistence and developing farming communities. As worldwide economic conditions have changed, many nations do not have sufficient funds to import synthetic pesticides or to subsidize their sale to farmers. This bibliography was organized to consolidate printed information on the effects of various plant parts, extracts, oils, and their active components on stored-product insects to assist interested persons in the search for effective, inexpensive alternatives to manufactured pesticides.

Many researchers have investigated the potential of plant materials to control stored-product insects and have characterized effective compounds. However, field trials have been conducted with only a limited number. In commercial use, pyrethrins and rotenones have set precedents for efficacy.

The value of plant materials effective against stored-product insects appears to be in the use of little-refined, locally-grown plants to protect the grains and legumes stored by farmers for family use and for marketing at a later time. Desirable characteristics of a natural pesticide would include the following: a hardy, fast-growing perennial or reseeding annual plant with high yield of active material; minimal care required with maturation at or just prior to harvest time; small-to-moderate amount needed with minimal preparation for use; slow degradation of active ingredient in stored grain; low mammalian toxicity.

Each document collected was assigned a number according to alphabetical sequence of author names. Some documents are themselves bibliographies containing references to the use of plant materials against stored-product insects (No's 65,66,67,95,110,112) or are reviews of the subject (No's 33,58, 93,110,112,117,120,127,128,133,134,144,161,215). Other papers of a general nature discuss advantages, disadvantages, and problems related to the use of plant materials with insecticidal properties (No's 12,34,42,49,53,54,61,84, 96,101,106,111,120,163,185,205,235,236,249,255,283,286). References documenting resistance of stored-product insects to plant materials with activity against other species are included.

To facilitate use of the references, tables present sources of information for plant species, vegetable oils, and crop residues. References listed in the tables are to specific reports and observations; notations in bibliographies and reviews are not included. For Table 1, Willis' A Dictionary of the Flowering Plants and Ferns was followed for plant nomenclature.

¹ Willis, J.C., 1973. A Dictionary of the Flowering Plants and Ferns, 8th edition. Cambridge University Press, London. 1333 pp.

The bibliography is not all-inclusive: several pre-1950 reports cited by authors were unobtainable, and although exhaustive computer searches were conducted, some non-English language papers could not be retrieved. Studies specifically addressing possible toxicity of the various plant parts and products reported to control stored-product insects were not found. Some information is available in a general pharmaceutical work as the CRC Handbook of Medicinal Herbs². However, one cannot assume that a plant used medicinally is safe for food-grain storage where both plant and grain may be consumed daily.

All documents listed in this bibliography are available in paper copy or microfiche from the Postharvest Documentation Service, Food and Feed Grains Institute, Kansas State University, Manhattan, Kansas 66506 USA.

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TABLE 1

Plants Tested for Control of Stored-Product Insects

ACANTHACEAE

Adhatoda vasica

7,12,95,130,189

265,266

Barleria sp. 229Justicia gandarussa 90

ANACARDIACEAE

Anacardium occidentale 12,106

ANNONACEAE

Annona reticulata

95,285,284,107,217

A. senegalensis 47,89A. squamosa 12,13

17,51,75,100,134

141,175,222,223,224

Annona sp. 188Artobotrys sp. 31Dennettia tripetata 114

APOCYNACEAE

Nerium odorum 230,36Rauwolfia serpentina 112Thevetia nerifolia 189,261,286

ARACEAE

Acorus calamus

7,8,24,25,31,88,93,95

121,132,136,137,138

155,189,197,244,282,290

292,293,294,296,307

ARISTOLOCHIACEAE

Aristolochia bracteata 245

ASCLEPIADACEA

Calotropis gigantea 134C. procera 230,12Tylophora sp. 31

BEGONIACEAE

Begonia picta 213,214,216Begonia sp. 194,195,210

BIGNONIACEAE

Tabebuia rosea 229Tecoma indica 230

TABLE 1 (cont.)

BURSERACEAE

- Boswellia carteri 76
Commiphora mukul 261

CANNABIDACEAE

- Cannabis satavia
22, 95, 137, 138, 162
194, 216

CANNACEAE

- Canna indica 230

CELASTRACEAE

- Celastrus angulata 53
Euonymus europaeus 286
Tripterygium wilfordii 286

CHENOPodiaceae

- Chenopodium anthelminticum 153

COMBRETACEAE

- Combretum sp. 97
Quisqualis indica 261

COMPOSITAE

- Ageratum conyzoides 95
precocene 68
Anacyclus pyrethrum 58, 60, 111
Anthemis cotuta 162
Artemesia absinthium 55
A. maritima 120
A. pallens 99
A. scopario 120
A. vulgaris 95
Artemesia sp. 93, 153
Asteriscus martinus 182
Callistephus chinensis 227
Chrysanthemum cinerariifolium 225
C. macrophyllum 182
pyrethrum, pyrethrins
14, 15, 21, 36, 40, 41, 46
48, 49, 74, 75, 79, 84
86, 88, 90, 94, 96, 100, 102
124, 134, 135, 141, 146, 147
148, 149, 150, 151, 155, 157, 159
160, 163, 173, 177, 184, 190
191, 192, 193, 202, 204, 207
108, 210, 212, 219, 229
230, 250, 283, 284, 294
Echinacea angustifolia 115, 116

TABLE 1 (continued)

-
- Eclipta alba 194, 210, 211, 216
Heliopsis longipes 77
Inula grandiflora 182
I. grandis 182
I. graveolens 93
I. macrocephala 182
I. magnifica 182
Parthenium hysterophorus 93, 179
Perezia multiflora 182
Saussurea lappa
 31, 50, 120, 129, 153, 240
Tagetes erecta 172
T. lucida 182
T. minuta 93
T. patula 172
Tagetes sp. 76
Telekia speciosa 182
Tridax procumbens 95, 229
Venidium hirsutum 182
Xeranthemum cylindraceum 182

CONVOLVULACEAE

- Ipomoea hederacea 120
I. cornea 95, 189

CRUCIFERAE

- Brassica napis 80, 134

CUCURBITACEAE

- Luffa acutangula 229
L. cylindrica 89

CUPRESSACEAE

- Juniperus virginiana 258
Thuja plicata 39

CUSCUTACEAE

- Cuscuta reflexa 36

CIPTEROCARPACEAE

- Shorea robusta 186, 254

ERICACEAE

- Rhododendron molle 286

EUPHORBIACEAE

- Euphorbia pulcherrima 230
Jatropha curcas 118
Ricinus communis 254

TABLE 1 (cont.)

FLACOURTIACEAE

Ryania speciosa 101,300

FUMARIACEAE

Fumaria sp. 31

GENTIANACEAE

Swertia chaemejasma 53

GRAMINEAE

Andropogon muricatus 220

Andropogon sp. 93

Citronella nardis 13,142

Cymbopogon citratus 142

C. martini 261

GUTTIFERAE

Calophyllum antillanum 204

C. tachymyllum 118,194,216

Mammea americana 12,61

JUGLANACEAE

Juglan sp. 52

LABIATAE

Hyptis spicigera 47,89,95,144

Lavandula gibsonii 256

Leonotis africana 63

L. nepetaefolia 63

Mentha arvensis 120

M. piperita 166

M. spicata 99,131,194,216

M. sylvestris 120

Ocimum americanum 89

O. basicilum 71

O. canum 142

Ocimum sp. 142

Pogotemon heyneanus 70

LAURACEAE

Cinnamomum 2,3,4,5,6,136

C. zeylanicum 38,82,142,260

Litsea cubela 308

LEGUMINOSAE

Acacia concinna 95,130,134,222

Afrormosia laxiflora 89

Caesalpinia bonduc 50

C. pulcherrima 229

Caesalpinia sp. 31

TABLE 1 (cont.)

-
- Cassia absus 120
C. fistula 95
C. nigricans 144,309
Cassia sp. 229,230
Crotalaria juncea 230
Derris elliptica, 156,161,286
D. fordii 286
D. malaccensis 156
 rotenone, derris
 87,135,141,151,161
 163,208,284
Dolichos buchanani 101
Erythrophleum guineense 89
Gliricidia sepium 205
Glycine max 279
Lochocarpus salvadorensis 45
Melilotus parviflora 219
Milletia pachycarpa 53,286
Mundulea sericea 141,286
Phaseolus vulgaris 177
Pisum sativum 56
Poinciana regia 229,230
Pongamia glabra
 12,13,75,193,194
 216,227,229,258
P. pinnata 93,95
Psoralea corylifolia 50
Swartzia madagascariensis 302
Tephrosia purpurea 243
Trigonella foenum-graecum
 54,95,123,153,183

LILIACEAE

- Agave americana 12,95
Allium cepa 189,210,212
A. sativum 38,43,44,95,121
 189,210,212,213,216

MALVACEAE

- Hibiscus rosa-chinensis 230

MARANTACEAE

- Maranta arundinacea 221

MELIACEAE

- Azadirachta indica
 7,10,11,12,13,16,18,19,23
 26,31,33,35,36,37,73,88,91
 93,95,107,108,109,113,117
 120,121,122,123,125,126,127

TABLE 1 (Cont.)

-
- 128, 130, 133, 134, 140, 141, 142
143, 154, 158, 174, 185, 189, 194
196, 198, 200, 209, 210, 212, 213
216, 219, 222, 223, 224, 225, 228
231, 232, 233, 239, 240, 241, 242
248, 253, 254, 257, 259, 263, 268
284, 291, 301, 309
Melia azadirachta 36
82, 93, 95, 106, 107, 133
134, 219, 240, 289, 292
- MYRSINACEAE
Embelia ribes 31, 50
Conomorpha peruviana var.
rostrata 101
- MYRTACEAE
Eucalyptus sp. 82, 142
Syzygium aromaticum 38, 142, 258
- NYCTAGINACEAE
Bougainvillea sp. 31, 229, 230
- OLEACEAE
Jasminum sp. 229
- OXALIDACEAE
Xanthoxylum armatum 120, 121
- PAPAVERACEAE
Argemone mexicana 230
- PEDALIACEAE
Sesamum indicum 193, 226
- PINACEAE
Chamaecyparis lawsoniana 115
- PIPERACEAE
Piper guineense 274, 278
P. longum 95
P. nigrum 15, 38, 95, 98
119, 145, 152, 168, 169, 170
272, 273, 274, 276

TABLE 1 (continued)

POLYGONACEAE

- Polygonum hydropiper 95
P. serrulatum 10

PRIMULACEAE

- Lysimachia nummularia 162

PUNICACEAE

- Punica granatum 249

RUBIACEAE

- Cinchona sp. 139
Coffea arabica 32, 184, 234
Gardenia jasminoides 134
Nigella sativa 70
Randia dumetorum 54, 183, 286
R. spinosa 302

RUTACEAE

- Aegle marmelos 194, 195, 216
Citrus aurantiifolia 1, 12
95, 142, 280, 281
C. aurantium 288
C. limon 1, 270, 280, 281
C. paradisi 1, 78, 280, 281, 287
C. reticulata 1, 280, 281
C. sinensis 280, 281, 287
Fortunella margarite 280, 281
Murraya koenigii 99
Skimmia laureola 153
Zanthoxylum alatum 93
Z. armatum 120, 121
Z. clavaherculis 59
Z. piperithum 111

SANTALACEAE

- Santalum album 252

SAPINDACEAE

- Sapindus emarginatus 105, 130
S. marginatus 12, 95
S. trifoliatus 99, 134, 222

SAPOTACEAE

- Butyrcspermum parkii 89
Madhuca latifolia 13, 18
95, 118, 194, 216
M. longifolia 99

TABLE 1 (cont.)

SOLANACEAE

- Capsicum annum 15,206,260
- C. frutescens 63,69,95
- Capsicum sp. 38,47,93,309
- Cestrum nocturnum 31,50
- Datura stramonium 89
- Nicotiana tabacum 10,95
- Nicotiana sp. 81,89,92
- nicotine 57,163
- 165,184,208,297
- Physalis minima 137,138
- Withania somnifera 31,50

SPIGELIACEAE

- Spigelia marilandica 101

TACCACEAE

- Tacca pinnatifida 89

TAXACEAE

- Taxus canadensis 201

THEACEAE

- Thea sinensis 181

TYPHACEAE

- Typha plicata 39

UMBELLIFERAE

- Anethum graveolens 275
- A. sowa 176,246,261,295
- dillapiole 75
- Carum capticum 120,121
- C. roxburghianum 31,50
- Coriandrum sativum 38,152
- Cuminum cyminum 38,152
- Peucedanum graveolens 120
- Pimpinella anisum 260
- Trachyspermum ammi 38

VALERIANACEAE

- Valeriana officinalis 120
- V. wallichii 153

VERBENACEAE

- Clerodendrum infortunatum 7,95
- C. interne 50
- Clerodendrum sp. 31
- Lantana camara 12,95

TABLE 1 (cont.)

L. rugosa 89
L. salvifolia 217
Lantana sp. 15, 210
Vitex negundo 7, 10, 12
54, 93, 95, 142, 163

ZINGIBERACEAE

Cucumis amada 31
C. angustifolia 15
C. domestica 264, 267
C. longa 9, 15, 93
95, 120, 123, 277
Elettaria cardamomum 38, 260
Kaempferia galanga 15, 99, 221
Zingiber officinale 15, 99

ZYGOPHYLLACEAE

Peganum harmala 36, 120

TABLE 2
Plant Oils Tested for Control of Stored-Product Insects

Oil	References Cited
Almond (<u>Prunus amygdalus</u>)	220
Cashew nut shell/cardanol (<u>Anacardium occidentale</u>)	13,106,208
Castor (<u>Ricinus communis</u>)	13,178,220,238,262
Coconut (<u>Cocos nucifera</u>)	13,18,29,73,75,104,114,140 167,178,220,247,266,298
Cottonseed/dalda (<u>Gossypium hirsutum</u>)	13,18,103,104,140 238,247,251,254
Flax linseed (<u>Linum usitatissimum</u>)	260
Groundnut (<u>Arachis hypogaea</u>)	13,27,75,81,164,167,178 199,220,254,262,298,309
Honge (<u>Pongamia galbea</u>)	238
Karité (<u>Butyra spermum parkii</u>)	190
Khaskhas (<u>Andropogon muricatus</u>)	220
Maize (<u>Zea mays</u>)	62,104,247,254
Mahua (<u>Bassia latifolia</u>)	18
Mustard (<u>Brassica juncea</u>)	18,29,75,178,220,238,260,298
Neem (<u>Azadirachta indica</u>)	199,238
Olive (<u>Olea europaea</u>)	13,104
Palm (<u>Elaeis guineensis</u>)	18,103,140
Palm kernel (<u>Elaeis</u> sp.)	104,167,199,247,262
Rape seed (<u>Brassica napus</u>)	18
Rice bran (<u>Oryza sativa</u>)	50,186
Safflower (<u>Carthamus tinctorius</u>)	29,164,238
Sal (<u>Shorea robusta</u>)	186

TABLE 2 (continued)

Oil	References Cited
Sesame/gingelly (<u>Sesamum indicum</u>)	13, 15, 18, 19, 29, 73 178, 220, 246, 260, 298
Soybean (<u>Glycine max</u>)	62, 104, 247, 254
Sunflower (<u>Helianthus annuus</u>)	81, 140, 178, 298

TABLE 3

Crop Residues Tested for Control of Stored-Product Insects

Residue	References Cited
Chaff	254
Bean pod ash	81
Paddy husks	83, 93, 141
Paddy husk ash	30, 73, 85, 93, 141, 155, 180, 194, 210, 229
Sawdust	92
Wood ash	64, 92, 93, 97, 136, 141, 143, 304, 309
Sorghum "straw"	93, 136
Millet stalk ash	18